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Research article

Recircumscription of the *Nepenthes alata* group (Caryophyllales: Nepenthaceae), in the Philippines, with four new species

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Abstract. An overview of *Nepenthes* in the Philippines is presented. Four new species, *Nepenthes extincta* sp. nov., *N. kitanglad* sp. nov., *N. kurata* sp. nov. and *N. leyte* sp. nov. are described and illustrated from the Philippines and placed in the *Nepenthes alata* group. An updated circumscription and key to the species of the group is provided. Delimitation and comparison with the *Regiae* group is given. All four of the newly described species are assessed as threatened using the International Union for the Conservation of Nature 2012 standard, and one, *N. extincta* sp. nov. is considered likely to be already extinct due to open-cast mining. Logging and conversion of forest habitat are thought to be the main threats to the other three species.

Key words. Conservation, *Nepenthes alata* group, Mindanao, threatened, ultramafic.

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Introduction

This paper forms part of studies towards a World Monograph of *Nepenthes* L. (Linnaeus 1753) (Nepenthaceae), building on a Skeletal Revision of *Nepenthes* (Jebb & Cheek 1997) and the Flora Malesiana account (Cheek & Jebb 2001).

Nepenthes is the sole genus in its family. The species mainly occur in Malesia, but with ca. 12 outlying species in Madagascar, Seychelles, Sri Lanka, NE India, Indochina, Solomon Islands, New Caledonia and Australia. Cheek & Jebb (2001) recorded 87 species of *Nepenthes*, but since 1st Jan. 2001, 50 new specific names have been published in the genus (International Plant Names Index continuously updated) and others have been resurrected from synonymy. The total number of species now accepted in the genus is estimated as140 and is set to rise further.

Within the Philippines 12 species were recognised in Cheek & Jebb (2001). Since 1st Jan. 2001, 16 new names have been published at species-level for the country (International Plant Names Index continuously updated). These derive mainly from exploration of previously unexplored areas by *Nepenthes* enthusiasts (e.g. Heinrich *et al.* 2009; Cheek 2011) and are also due to the discovery of

previously overlooked specimens in herbaria around the world (e.g. Cheek & Jebb 2013a, b, c, d). Some of the latter, e.g. *Nepenthes alzapan* Jebb & Cheek (Cheek & Jebb 2013b) are considered possibly already extinct, since habitat destruction in the Philippines over the last 100 years has been so extensive. The Philippines is thought to have remained two-thirds forested as recently as 1925 according to Sohmer & Davis (2007). Myers *et al.* (2000) estimated that remaining primary vegetation in the Philippines 75 years later amounted to only 3%. Lowland primary forest (occurring below 500 m) has now all but gone from the Philippines (Sohmer & Davis 2007). Sohmer & Davis (2007) estimate species extinction levels due to habitat destruction as between 9 and 28% in one representative, mainly forest genus, *Psychotria* L. (Linnaeus 1759) (Rubiaceae) which they revised taxonomically for the Philippines. Since habitat destruction continues in the Philippines, it is a race against time to discover, publish, assess and draw attention to the conservation needs of species before they become extinct, if they have not already been lost.

Of the species of *Nepenthes* known for the Philippines, about half occur in scrub or stunted habitats on ultramafic substrates (both lowland and submontane) and appear to be restricted to this substrate, while the remainder occur mainly in submontane forest (500–2000 m) on non-ultramafic, mainly volcanic substrates. Species diversity is highest on Mindanao Island, the southernmost and second-largest island, followed by Palawan Island.

All known Philippine *Nepenthes* species are endemic, apart from *N. mirabilis* Lour. (Druce) (Druce 1916; basionym: Loureiro 1790) which is known from Tawi Tawi Island close to Borneo, and from the northern coast of Mindanao and its associated islands.

Phytogeographically, the *Nepenthes* of Palawan have closer affinities with Borneo than with the rest of the Philippines (Cheek & Jebb 1999).

Most of the endemic species can be assigned to one of three main groups:
(1) The *Nepenthes villosa* Hook.f. (Hooker 1851) group, with petiolate leaves, well-developed lid columns, and peristomes with blade-like teeth, and lids which lack a basal appendage. These are restricted to higher altitude ultramafic habitats and are most diverse in Palawan, but extend to NE Borneo (Cheek & Jebb 1999: 894).
(2) The *Insignes* or *N. ventricosa* Blanco (Blanco 1837) group which is most diverse in the Philippines (but absent from Palawan), extends to New Guinea and to Borneo and is characterised in Cheek & Jebb (2013b). In the Philippines they occur in both ultramafic and non-ultramafic, mainly submontane forest habitats. Its species lack a petiole, have broadly subcylindrical pitchers with a broad peristome which is conspicuously toothed on its inner surface, lids which lack appendages, and which have transversely elliptic nectar glands except along the midline band.
(3) The *Nepenthes alata* Blanco (Blanco 1837) group, characterised in Cheek & Jebb (2013d), is endemic to and extends throughout the Philippines except Palawan, is most diverse in Mindanao, and occurs in the same range of habitats as the *Insignes*. Its species have winged petioles, lids with basal ridges, usually producing appendages and upper pitchers usually broadest at the base.

Outside of these three groups, three other species occur, namely *N. philippinensis* Macfarl. (Macfarlane 1908), *N. abalata* Jebb & Cheek (Cheek & Jebb 2013a: 153) and *N. micramphora* V.B.Heinrich, S.McPherson, Gronem. & V.B.Amoroso (Heinrich *et al.* 2009). *N. philippinensis* is endemic to Palawan, and part of the *N. hirsuta* Hook.f. (Hooker 1873) group otherwise restricted to Borneo (Cheek & Jebb 1999: 890–891). The unusual *N. abalata* occurs only in the small low-lying, drier islands between Palawan and Panay Islands. It appears to be restricted to grassland and is similar and possibly related to the grassland species of Indo-China. Finally, *N. micramphora* of the extreme SE of Mindanao fits none of these groups and has an isolated position.

Many Philippine species of *Nepenthes* are only known from a single, sometimes sterile, specimen. However, usually there is little doubt that they are distinct taxa, since most characters of use in delimiting species in the genus are found in the pitchers and not in the flowers or fruit. In *Nepenthes* the large number of taxonomic characters in the pitcher morphology and micro-morphology, especially in the upper and intermediate pitchers, parallels the importance of characters present in the flowers and inflorescences of many other plant groups. In many other plant groups evolution of character diversity in floral characters appears to be correlated with assisting pollination, often by a single or narrow range of insect species. In *Nepenthes*, cross-pollination appears from initial studies to be performed by a broad range of generalist flies and wasps (Lian 1995; Adam 1998). Perhaps for this reason there is comparatively little species-level differentiation florally in the family. In contrast, evidence has been steadily accumulating in recent years that the pitchers of different *Nepenthes* species are specialised at gathering nutrients from one of a variety of animal sources. They are not always pitfall trappers of any prey item that happens to fall in, as had previously been assumed. *Nepenthes* species studied by Jebb (1991) in New Guinea predominantly trapped ants, but also a spectrum of other insects, while *Nepenthes albomarginata* T.Lobb ex Lindley (Lindley 1849) traps almost exclusively a species of termite (Clarke 1997). *Nepenthes hemsleyana* Macfarl. (Macfarlane 1908), the pitchers of which, providing day roosts for a species of bat, benefit from the resulting faecal deposits produced (Grafe *et al.* 2011), while a group of *Nepenthes* species in montane Borneo are adapted to attract, detain and collect the faeces of a species of tree shrew and a rat (Greenwood *et al.* 2011). In each of these cases modification in the morphology and micro-morphology of the pitchers appears to have been critical to collect nutrients from the target animals.

No doubt in future, morphological and micromorphological character states seen in the pitchers of other *Nepenthes* species or species groups, will also be shown to be important to targeting hitherto unsuspected specialised animal nutrient sources.

In the last three cases, the morphological modifications of the pitcher each appear to target only one or two species of animal. However, it is possible that future studies will show that some or most species of *Nepenthes* trap a wider range of insect species available in their environment. Since the range of e.g. arthropod species can be expected to vary from one mountain (or other geographic location) to another, it is possible that speciation in *Nepenthes* might be driven by modifications of the pitcher caused by selection for efficiency in trapping, or otherwise targeting, the spectra of animal species present at each. This might explain the common pattern seen in several *Nepenthes* groups to have different species, as recognised by pitcher morphology and micromorphology, on different mountains or islands.

An alternative hypothesis to explain this speciation pattern invokes genetic drift (Stace 1991). In this hypothesis, the progeny of the few founding individuals at a new location might accumulate morphological changes over time independent of any selection pressures, for example as postulated for Podostemaceae Rich. ex Kunth (Kunth 1816) species at the same waterfall by van Steenis (1981), exemplifying his theory of autonomous evolution. This scenario assumes that animal targeting is not strongly selected for in *Nepenthes*. This might be the case if the threshold for the need for nutrients derived from animals in *Nepenthes* is very low, or if there is no threshold at all, for example if *Nepenthes* can survive without capturing animal nutrients through their pitchers.

Materials and Methods

The data in this study, one of a series, derives from herbarium specimens including their corresponding field notes, and if available, photographs. The location of the herbarium at which the specimens are located is indicated by the citation of the international code registered in Index Herbariorum (Thiers continuously updated).

The shape and dimensions of the upper and intermediate pitchers, including those of the body, mouth and lid of the pitcher, and of the fringed wings if present, are useful characters. The shape and features of the lower surface of the pitcher lid, and the shape of the pitcher mouth and its peristome are the largest source of such characters, as are the nectar glands on the lower surface of the lid (Cheek & Jebb 2001). The nectar gland size, shape, orientation, position, density and the absence or, if present, the extent of a nectar gland perimeter wall, can be especially useful in delimiting species. In some species nectar glands are dimorphic, and in a very few, trimorphic. Indumentum is also frequently an important source of species characters. Here the classification used in Cheek & Jebb (2001: 7-8) is maintained.

Since the mouth and the lid surface are often obscured or not presented in mounted herbarium specimens of *Nepenthes*, it is frequently necessary, after prior permission from the herbarium manager of the specimens concerned, to soak the mouth area and lid, and sometimes entire pitchers, in warm soapy water so that they can be repositioned for study of the mouth and lower surface of the lid. By this means it is possible to view the three-dimensional shape of the pitcher, if this is not already known from photographs or observation of live material.

Measurements are made of stem, leaf and pitcher dimensions using a graduated ruler. The full range of measurements is given in the description, with extreme dimensions, disconnected with the normal range, indicated in brackets, e.g. "leaf-blade 12.5–22(–28) cm long", indicating that a single leaf-blade was measured as 28 cm long, all others being in the 12.5–22 cm long range. Observations and measurements of hair dimensions and of peristome and lower lid details are made with a Leica Wild M8 binocular microscope fitted with an eyepiece graticule graduated in units of 0.025 mm at X40 magnification. The drawings were prepared with the aid of a *camera lucida* fitted to the microscope.

The four species described as new in this paper, *N. extincta* sp. nov., *N. kitanglad* sp. nov., *N. kurata* sp. nov. and *N. leyte* sp. nov. came to light when examining loans of previously unstudied specimens from E, BISH and BRIT, which were compared with material from B, BM, BO, F, GH, K, KEP, L, NDC, NY, PH, S, W, WAG, U, UC, US, on which earlier studies have been published (Jebb & Cheek 1997; Cheek & Jebb 1999, 2001; Cheek 2011; Cheek & Jebb 2013a, b, c, d). The material referred to matched no other species description, as represented by the both the specimens from the herbaria cited, and by protologues and other literature regarding the species for which material is only available in the Philippines and not available for loan. The material best fitted the characters of *Nepenthes* group (3) described above, that is the *Nepenthes alata* group. However, unusual features for this group were present, which are considered in the discussion at the end of this paper. A key to the species of the group is provided below.

The rapid increase in the number of new species from Mindanao in recent years is likely to continue as specimens become available from new areas. Many of the species of the *N. alata* group on this island seem narrowly geographically localised, although others, such as *N. graciliflora* are widespread.

Results

Key to the species of the *Nepenthes alata* group updated from Cheek & Jebb (2013b)

1. Lower surface of lid, including appendage (if present), densely and evenly covered in uniformly minute circular nectar glands (0.15–0.2 mm diam.) .....…….....…….. 2
– Lower surface of lid with nectar glands either absent from the appendage (if present) and/or, sparse, large or dimorphic (larger glands 0.35–0.4 mm diam. or larger) .....…….. 3

2. Stems glabrous to glabrescent; upper pitchers lacking fringed wings in upper part; outer surface lacking stellate hairs entirely. S LUZON TO MINDANAO ..... ***N. graciliflora*** Elmer (Elmer 1912)

– Stems persistently pubescent; upper pitchers with fringed wings in upper part; outer pitcher surface > 50% covered in grey stellate hairs. N LUZON ..... ***N. alata*** Blanco (Blanco 1837)

3. Stem internodes winged from the decurrent petiole bases. MINDANAO, SARANGANI PROV. .... ***N. saranganiensis*** Sh.Kurata (Kurata 2003)
– Stem terete or angular, lacking wings 4

4 Upper pitchers funnel-shaped or funneliform-cylindric 5
– Upper pitchers not funnel-shaped, but subcylindric, widest at base, or equally at base and apex 6

5. Stems and abaxial surface of midrib moderately densely covered in white appressed hairs 0.5–1.5 mm long; lid of upper pitchers ovate, longer than broad. Volcanic substrate. MINDANAO, MTS APO & MATUTUM .....… ***N. copelandii*** Macfarl.(Macfarlane 1908)
– Stems and leaf-blades glabrous; lid of upper pitcher broader than long. Ultramafic substrate. MINDANAO, MT KIAMO ..... ***N. ceciliae*** Gronem. *et al.* (Gronemeyer *et al.* 2012)

6 Petiole appearing flat, at least distally (wings held flat) 7
– Petiole appearing cylindrical (wings incurved) 12

7. Stems and lower surface of midrib conspicuously densely pubescent; lid appendage well-developed, hooked 8
– Stems and inner surface of midrib glabrous or inconspicuously and sparsely pubescent; lid appendage moderately or well-developed, never hooked 9

8. Upper pitchers widest at base, contracting slightly above into a narrower cylinder with fringed wings. NEGROS & BILIRAN ISL. ……..…… ***N. negros*** Jebb & Cheek (Cheek & Jebb 2013d)
– Upper pitchers equally wide at base and apex, contracting slightly at the middle, lacking fringed wings. MINDANAO, SURIGAO PROV. .....… ***N. ramos*** Jebb & Cheek (Cheek & Jebb 2013c)

9. Lid apex with pocket. MINDANAO, S COTABATO ..... ***N. tboli*** Jebb & Cheek sp. ined.
– Lid apex lacking pocket or any appendage 10

10. Petiole canaliculate proximally (flat distally); blade hairy on upper surface; upper pitchers stout, length: breadth ratio 2–2.5:1; fringed wings absent. MINDANAO, MT HAMIGUITAN .... ***N. hamiguitanensis*** Gronem. *et al.* (Gronemeyer *et al.* 2010)
– Petiole flat proximally; blade glabrous on upper surface; upper pitchers slender, length: breadth ratio > 3:1; fringed wings present below peristome ……..……. 11

11. Upper pitcher with lid about half as long as mouth; mouth not concave but flat; column absent; lid base truncate. MINDANAO, MT MALINDANG ……..…… ***N. kurata*** Jebb & Cheek sp. nov.
– Upper pitcher with lid about as long as mouth; mouth highly concave; column present; lid base cordate. MINDANAO, KITANGLAD MTS ……..……. ***N. kitanglad*** Jebb & Cheek sp. nov.

12. Largest pitchers robust, 18–24 cm long; peristome 7–8 mm wide, curved in section but not cylindric; inner edge of peristome with small teeth visible, outer edge lobed. MINDANAO ……..……...13
– Largest pitchers 12 cm long; peristome 2–3 mm wide, narrowly cylindrical, inner edge lacking visible teeth (unless dissected), outer edge not lobed. LEYTE ISL. ..... ***N. leyte*** Jebb & Cheek sp. nov.

13. Largest pitchers without fringed wings; leaf midrib densely, minutely white stellate-hairy; lid base deeply cordate. MINDANAO, RED MT ….....…… ***N. extincta*** Jebb & Cheek sp. nov.
– Largest pitchers with fringed wings; leaf midrib with brown black bristle-like hairs 1–1.5 mm long; lid base truncate. NE MINDANAO …….....…… ***N. mindanaoensis*** Sh.Kurata (Kurata 2001)

Taxonomic descriptions

Order Caryophyllales Juss. ex Bercht. & J.Presl. *sens. lat.* (Berchtold & Presl 1820)
Family Nepenthaceae Dumort. (Dumortier 1829)
Genus *Nepenthes* L. (Linnaeus 1753)

Nepenthes kurata Jebb & Cheek sp. nov.
urn:lsid:ipni.org:names:77134486-1
Fig. 1

Diagnosis

Differs from *N. mindanaoensis* Sh.Kurata in the petiole wings patent (not involute), the hairs of stem, midrib and leaf-edge bushy, 0.1 mm long, not bristle-like 1–1.5 mm long; the lid about half as long as the mouth, lid base rounded or truncate (not about as long as the mouth, base cordate).

Etymology

Named as a noun in apposition for Shigeo Kurata, whose book on the *Nepenthes* of Mount Kinabalu (Kurata 1976) inspired interest in the genus among its many readers, and whose descriptions of *Nepenthes* are models of detail, precision and clarity.

Type

PHILIPPINES. Mindanao, "Prov. of Misamis, Mount Malindang". May 1906, *Mearns & Hutchinson in Forest Bureau 4632* (holotype K!; isotype PH!). Fig 1.

Synonym

Nepenthes alata Blanco var. *ecristata* Macfarlane, Nepenthaceae. *In*: Engler A. (ed.) *Das Pflanzenreich* Heft 36, 4, 3: 72 (1908). – Type: lectotype, **designated here**: Philippines, Mindanao, "Prov. of Misamis, Mount Malindang", May 1906, *Mearns & Hutchinson in Forest Bureau 4632* (lecto-: K!; isolecto-: PH!).

Description

Terrestrial shrub-climber, height unknown. Climbing stems terete to slightly angular, 4–6 mm diam.; internodes 30–50 mm long; axillary buds not evident; indumentum inconspicuous, persistent to the fifth internode from the apex, hairs translucent brown, simple or 2–3-armed from the base, hairs straight, variously angled from the horizontal, ca. 0.1 mm long, covering ca. 5% of the surface except the axils (100% coverage) surface brown-black, matt. Leaves of rosette shoots thinly coriaceous, blade narrowly elliptic, 8–9 × 2–2.5 cm; apex and base acute; longitudinal nerves 1–2 pairs, within 2 mm of the margin, moderately conspicuous on both surfaces; pennate nerves at 90° from the midrib, numerous and moderately conspicuous; upper surface drying glossy pale brown, lower surface matt, mid-brown. Leaves of climbing stems as the rosette leaves, but blades suboblong or oblong-lanceolate 10–12.5 × 3.2–3.8 cm; apex obtuse or acute; base obtuse; lower surface with sessile red glands ca. 0.5 mm diam.; midrib 40–60% covered in patent, brown, simple or basally bifurcate-trifurcate hairs 0.1–0.3(–0.5) mm long; margin fringed, in young leaves, with hairs 0.25 mm long, pale-brown, 1–4-armed from the base. Petiole winged-canaliculate, 4–5 × 0.7 cm, wings patent; base clasping the stem for ⅓ to ½ its circumference, sometimes decurrent as an obtuse ridge to the node below. Lower

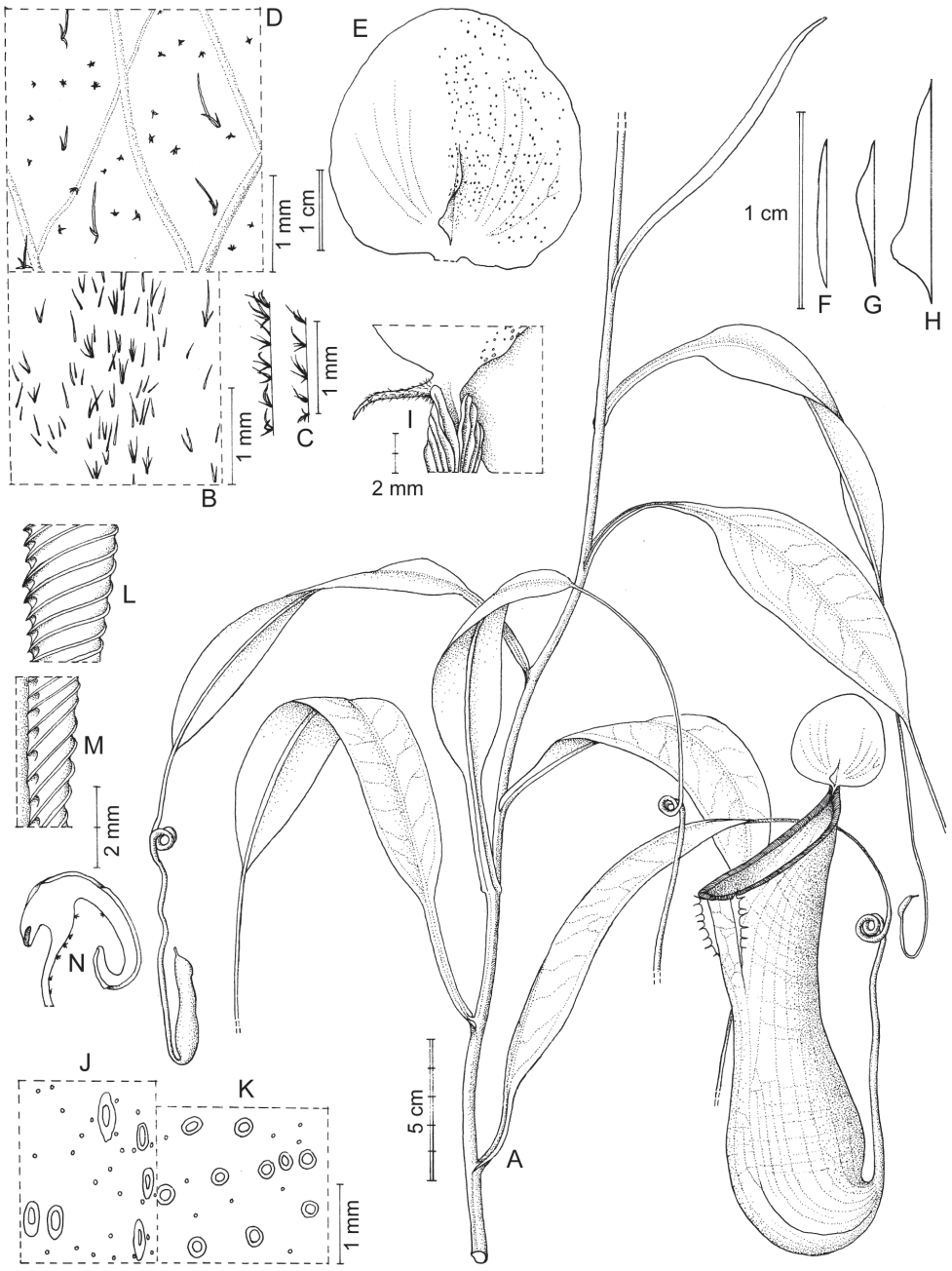

Fig. 1. *Nepenthes kurata* sp. nov. **A**. Habit, climbing stem with upper pitcher. **B**. Indumentum of midrib, lower surface of leaf-blade. **C**. Indumentum of tendril. **D**. Indumentum of outer pitcher surface. **E**. Lid, lower surface, showing nectar gland distribution on right (upper pitcher). **F–G**. Profiles of basal lid ridges, without appendage (**F**), with appendage weakly developed (**G**), and moderately developed (**H**). **I** Spur of intermediate pitcher. **J**. Longitudinally elliptic nectar glands of lid midline. **K**. Orbicular nectar glands of lid, outside the midline. **L**. Peristome from above, short teeth and holes discernible. **M**. Peristome viewed from inside pitcher. **N**. Peristome transverse section, outer surface to right. A–E, J & K from *Gaerlan et al. PPI 10911*; F–I, L–N from *Mearns & Hutchinson 4632*. Scale bars: single = 1 mm; graduated single = 2 mm; double = 1 cm; graduated double = 5 cm. All drawn by Andrew Brown.

pitchers unknown. Intermediate pitchers (tendrils uncoiled: *Mearns & Hutchinson 4632*) 12.5–17.2 cm long, ellipsoid in the basal third to half, 4–5.7 cm wide, constricted, more or less abruptly, 5–7.5 cm from the base into the subcylindrical upper part, 2.1–3 cm diam. dilating slightly towards the apex 3–4 cm diam.; outer surface strongly reticulated with raised nerves when dry, 2–5% covered in hairs of two types (Fig. 1D), (1) large erect hairs 0.3–0.75 mm long, with a single, major, curved arm, and 1–2 much smaller erect arms, and (2) minute, 3–6-armed stellate hairs 0.05–0.1 mm diam., which are more frequent, (ca. 4 per mm^2); surface covered throughout (6–10 per mm^2) with sessile, depressed-globose glands 0.1–0.2 mm diam.; fringed wings reduced to ridges except in the ca. 25 mm below the peristome, widening to 3 mm broad, with fringed elements 2.5 mm long, 2–5 mm apart; mouth oblique, suborbicular, ovate, 3–4.8 × 2.7–4.5 cm; apex with a column 9–10 mm long; peristome rounded to slightly flattened, 2–2.5 mm wide, more or less even in width, ribs 0.25–0.5 mm apart, conspicuous, about 0.1 mm high, outer edge lacking lobes, inner edge with very short teeth and conspicuous holes, teeth < 0.1 mm long. Lid much smaller than the mouth, ovate, or broadly ovate, 25–35 × 25–30 mm, apex rounded to obtuse, base rounded to truncate; lower surface with a low basal ridge ca. 1 mm high, 7–10 mm long, either lacking a protruding appendage entirely (Fig. 1F) or with a modestly developed appendage 1–2 mm high (Fig. 1H); nectar glands only slightly dimorphic, (1) midline nectar glands sparse, longitudinally elliptic, 0.5–0.7 × 0.1–0.25 mm, with a thin marginal rim (Fig. 1J), (2) outside the midline nectar glands circular (Fig. 1K), sparse, < 1 per mm^2, only 35–50 on each side of the midline, the largest scattered in the distal half, 0.5 mm diam., grading down to those of the marginal equatorial areas ca. 0.25 mm diam., and those at the attachment point with the peristome and the basal ridge and appendage, 0.15 mm diam.; sessile depressed-globose minute red glands 0.1–0.2 mm diam. are scattered over the surface at a density of 3–8 glands per mm^2; minute inconspicuous stellate hairs ca. 0.075 mm diam. occur in an uneven, 0.5–1 mm wide band, near the margin widening to 1.5 mm wide at the lid apex. Spur unbranched, curving downwards, stout at base and tapering to a slender apex, ca. 5 mm long, with scattered long, subpatent hairs 0.3–0.7 mm long (Fig. 1I). Upper pitchers (tendril coiled, *Gaerlan et al. in PPI 10914*) resembling the intermediate pitchers, but fringed wings 1–2 mm wide, fringed elements 2.5 mm long, (2–)4–5 mm apart, dilating to 4.5 cm below the mouth; pitcher green, peristome maroon. Lid broadly ovate to suborbicular 32 × 35 mm, lower surface with a basal ridge 9–10 mm long, ca. 2 mm high, bearing a central, symmetrical, protruding appendage 2 × 3 mm; nectar glands denser, ca. 110 on each side of the midline. Male and female inflorescences and infructescences unknown.

Additional material

PHILIPPINES. Mindanao, Prov. Misamis Occidental, S.E. slopes of Mt. Malindang, Lake Duminagat, May 1993, *Gaerlan, Sagcal & Romero in PPI 10911* (BRIT!).

Distribution, habitat & phenology

Philippines, Mindanao; evergreen forest, volcanic substrates. Elevation: ca. 1400 m.

Conservation status

Nepenthes kurata sp. nov. is here assessed as Critically Endangered under Criterion D of IUCN (2012) since currently only two individuals, probably at a single location (as currently defined by IUCN) are known. This site, the ca. 6 ha crater Lake Duminagat, is within the ca. 50,000 ha Mt Malindang Range Natural Park of which at least 20,000 ha has been cleared for cultivation purposes, but which is a tentative World Heritage Site (http://whc.unesco.org/en/tentativelists/5029/, downloaded 16 July 2013). In 2012 the Park was designated as an ASEAN Heritage Park (http://news.pia.gov.ph/index.php?article=1451343449808, downloaded 16 July 2013). It is to be hoped that further investigation will discover additional individuals and locations for this species, decreasing its threat status, and increasing the likelihood that it can be protected.

Since the terrain of Mt Malindang is reported as being rugged, with much forest surviving, there is every reason to hope that the species survives there, unlike *Nepenthes robcantleyi* Cheek (Cheek 2011) also from Mindanao, which is already suspected to be extinct in the wild due to the almost total clearance of forest habitat at the single known wild location due to logging (Cheek 2011).

Remarks

The first *Nepenthes* taxa described from Mindanao, both of the *N. alata* group, (Cheek & Jebb 2013d), were *N. alata* var. *ecristata* Macfarl. (Macfarlane 1908), based on *Mearns & Hutchinson 4632* from Mt Malindang, and *N. copelandii* Macfarl. (Macfarlane 1908) from Mt Apo.

The first of these we here elevate to species level as *N. kurata* Jebb & Cheek sp. nov. Previously we had considered this taxon to be synonymous with *N. mindanaoensis* Sh.Kurata (Kurata 2001) (Cheek & Jebb 2013d). The two taxa do have similarities in the overall shape of the upper pitchers, the weakly to moderately developed basal lid appendage and the sparse nectar glands of the lower lid surface. However they can be distinguished using the characters in Table 1. The number and extent of these features merit elevation from varietal to specific-level recognition in our opinion. Although the type specimen has rosette stems and intermediate pitchers only, a second specimen, with climbing stems and upper pitchers, *Gaerlan et al. in PPI 10911* came to light recently. It is from the type locality and matches the type in essential details. *Nepenthes kurata* sp. nov. has the spot character within the *Nepenthes alata* group of a small, more or less orbicular lid, only about half the length of the pitcher mouth.

Macfarlane (1908) characterised his *N. alata* var. *ecristata* by the lid appendage being either reduced or absent; the nectar glands being few, medium to large in size, and irregularly dispersed. Of the single specimen cited (*Mearns & Hutchinson 4632*), only two sheets (PH and K) have been found, both annotated in Macfarlane's hand, each with two intermediate pitchers. Although all four pitchers share a basal ridge (Fig. 1F–H), only one of the four has an appendage, and that is only moderately developed as a convex emergence from the basal ridge (Fig. 1H). However a recent collection (*Gaerlan et al. in PPI 10977*) with upper pitchers, does show a developed appendage (Fig. 1E), suggesting the epithet *ecristata* "lacking a crest" is inappropriate. In any case, the Code demands priority only at one rank, so there is no requirement to adopt the varietal epithet at specific level, for which reason Macfarlane's taxon is re-named as *N. kurata* sp. nov.

The upper pitchers also differ from the intermediate pitchers in the greater density of the nectar glands on the lower surface of the lid. However the shape, distribution and size of the nectar glands remain similar.

This is the only known species of *Nepenthes* from Mt Malindang at this time, and it is therefore the most westerly known species of the genus in Mindanao. *Nepenthes kurata* sp. nov. is still incompletely known, full details on its ecology, altitudinal range, population density, inflorescences and infructescences, and ethnobotany remain to be discovered.

The type specimens were collected by Major E.A. Mearns and W.J. Hutchinson in 1906 on the first recorded ascent of Mt Malindang, a volcanic mountain in the NW of Mindanao. Both sheets are annotated in the hand of Macfarlane as "*N. alata* var. *ecristata* Macfarlane", and either could be selected as lectotype of that name. The K sheet is accordingly selected.

Table 1. Diagnostic characters separating *N. kurata* sp. nov. and *N. mindanaoensis*.

	Nepenthes kurata sp. nov.	***Nepenthes mindanaoensis***
Geography	Mt Malindang, NW Mindanao	Surigao Prov. NE Mindanao
Substrate	Volcanic	Ultramafic
Habitat m a.s.l.	Submontane forest; ca. 1400 m	Open scrub; 200–300 m
Indumentum (stem, leaf midrib and margin	Translucent-brown, simple or bushy, 0.1 mm long	Dark red-brown, bristle-like hairs 1–1.5 mm long
Lower surface leaf-blade	Hairs absent (except midrib)	Hairy
Petiole wings	Patent	Involute (petiole appearing cylindrical)
Longitudinal nerves of leaf-blade	Arising along length of midrib	Arising from petiole
Pitcher lid base	Truncate or rounded	Deeply cordate
Mouth:lid (length ratio)	ca. 2:1	0.9–1.2:1
Midline nectar glands of lower lid surface	Longitudinally elliptic (versus circular outside midline)	Circular, not differentiated from those of the rest of the lid

Nepenthes kitanglad Jebb & Cheek sp. nov.
urn:lsid:ipni.org:names:77134487-1
Fig. 2

Diagnosis

Differs from *N. saranganiensis* Sh.Kurata in having angled, (not winged) stems, lower and upper pitchers strongly dimorphic, (not subdimorphic); in being a climbing epiphyte of forest (not a terrestrial shrub of open areas) and in having a strongly concave pitcher mouth with a long neck (not with the pitcher mouth flat or only slightly concave, lacking a neck).

Etymology

Named, as a noun in apposition, for Mt Kitanglad, the type and only known locality of the species.

Type

PHILIPPINES. Mindanao, Bukidnon Province, Intavas, Impasug-ong, Mt Kitanglad, 18 Jul. 1991, *Gaerlan, Sagcal & Fernando in PPI 3274* (holotype BISH!; isotype BRIT!).

Description

Epiphytic climber, probably 1 m tall or more. Short stems terete, 4–5 mm diam., internodes ca. 6 cm long, axillary buds not evident; surface glossy, appearing glabrous but with extremely sparse brown, simple hairs ca. 0.5 mm long, glabrescent. Climbing stems strongly 4-angular, 7–9 mm diam., internodes 11–12 cm long; indumentum as short stems. Leaves of short, and of climbing stems more or less identical, thickly papery; blade oblong-elliptic, 15.5–33 × 4.3–7 cm; apex acute, not peltate, tendril arising abruptly; base cuneate, decurrent to petiole; longitudinal nerves 3–4 pairs, conspicuous in the marginal half on the upper surface; pennate nerves arising at about 45° from the midrib, irregular, reticulate, branching in the marginal half; drying brown-black above, matt mid-brown below, appearing glabrous apart from margin but with indumentum as stem, densest on midrib but soon glabrescent; lower surface with sessile depressed-globose red-black glands ca. 0.05 mm diam.; margin densely fringed with soft fine orange-brown patent simple or bifurcate hairs 1 mm long. Petiole evenly winged along its length, 4–5 × 0.4–0.9 cm, wings patent; at base clasping the stem for ⅔ to ¾ of its circumference, decurrent

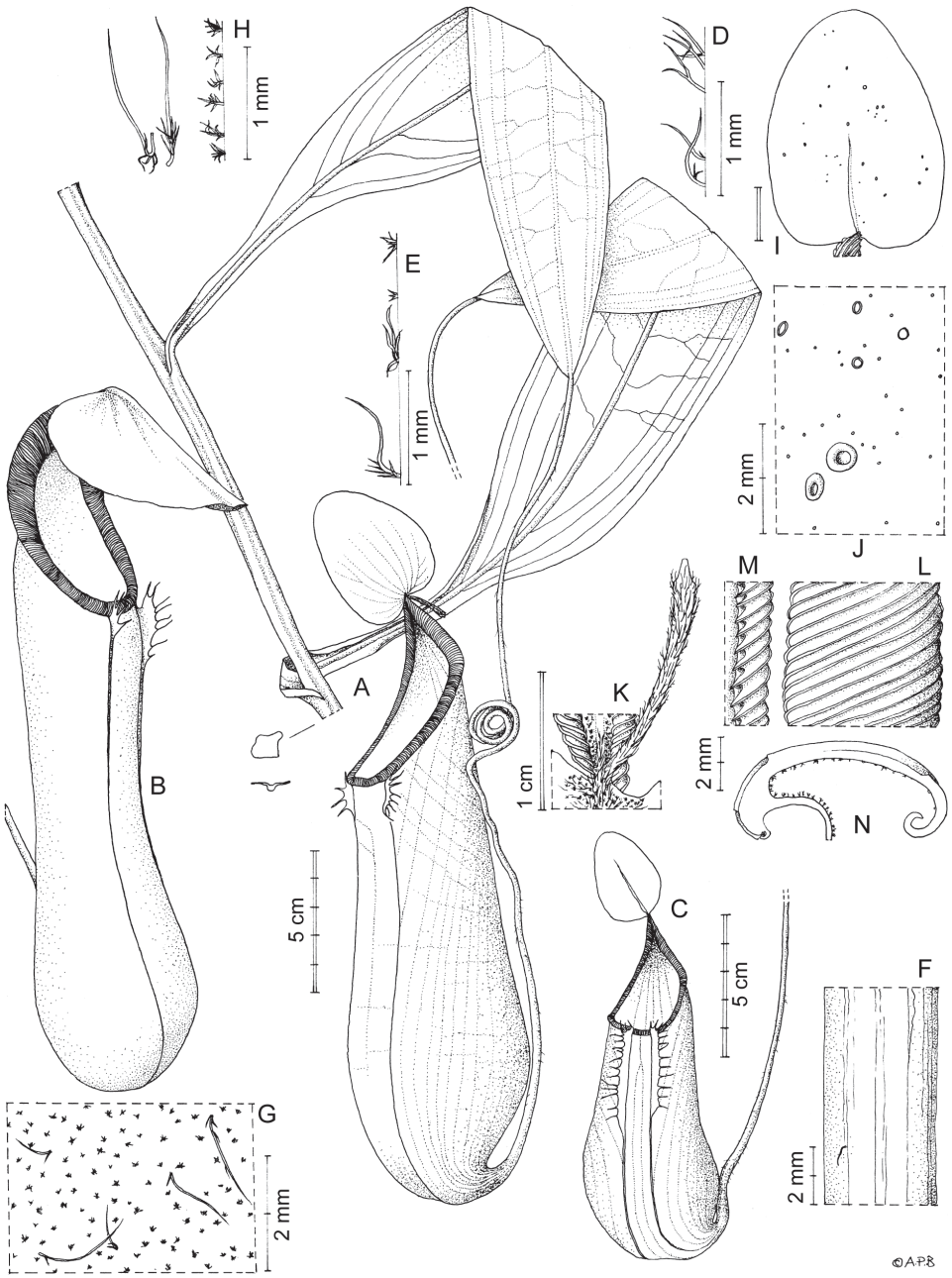

Fig. 2. *Nepenthes kitanglad* sp. nov. **A**. Habit, climbing stem with upper pitcher (from herbarium specimen). **B**. Upper pitcher (from live plant). **C**. Lower pitcher. **D**. Indumentum from leaf margin. **E**. Indumentum from tendril. **F**. Indumentum from stem (extremely sparse hairs). **G**. Indumentum of outer pitcher surface, plan view. **H**. *Ibid.*, profile view. **I**. Lower surface of lid (upper pitcher). **J**. Detail of glands from lower surface of lid. **K**. Spur of upper pitcher. **L**. Peristome, upper pitcher, view from above. **M**. Peristome, view from inside of pitcher, showing minute teeth. **N**. Peristome, transverse section (outer surface on right). A, D–N from *Gaerlan et al*. *in PPI 3274* (BISH); B from McPherson (2009: Fig 417); C from *Gaerlan et al. in PPI 3274* (BRIT). Scale bars: double = 1 cm; double graduated = 5 cm; single = 1 mm; single graduated = 2 mm. All drawn by Andrew Brown.

diagonally as a narrow wing, in short stems 7 mm long, in climbing stems 18 mm long, and continuing as a ridge to the node below. Lower pitchers narrowly ovoid-cylindric, 12.5 cm tall, 5 cm broad, widest in the basal half, narrowing steadily to ca. 3 cm wide below the peristome; outer surface 10–25% covered in pale brown hairs of two types, (1) bushy brown hairs 0.1–0.25 mm long and wide, with 4–8 arms ascending from a short central axis, 7–12 per mm^2, (2) long brown straight erect hairs 1.5–1.75 (–2.5) mm long, with 2–4 short branches ascending from along the length of the main axis, sparse; fringed wings, 2–4 mm wide, running 3–4 cm from peristome towards base of pitcher, then diminished to slender ridges, wings extended over the peristome by two foliose flaps 3–4 × 3–4 mm, fringed elements 4–5 mm long, 2.5 mm apart (1.5 mm apart on foliose flaps); mouth ovate-lanceolate, highly oblique, concave, ca. 4.1 × 2.8 cm; column developed, tapering towards lid ca. 9 mm long, 2.5 mm wide at midpoint; peristome subcylindric, 1 mm wide at front of pitcher to 3 mm wide at sides, ridges ca. 2.5 per mm, ridges 0.1 mm high, inner edge lacking conspicuous teeth or holes, outer edge not lobed. Lid narrowly ovate to rhombic 3.5 × 2.3 cm, apex rounded, base rounded to truncate, lower surface lacking a basal appendage, but with a low basal ridge 10 mm long, 0.5–1 mm high, extending from the junction with the peristome; nectar glands small and sparse, 6–8 on each side of the midline which mainly lacks glands, absent from basal ridge, nectar glands monomorphic, slightly perithecoid, orbicular or slightly elliptic, 0.25(–0.35) mm long, mixed with denser sessile depressed-globose, red-black glands, 0.05–0.1 mm diam., 8 per mm^2; marginal 2–3 mm of lower surface with minute stellate hairs densest near margin; upper surface with same indumentum as outer pitcher surface, but long hairs rarely seen. Spur not seen. Upper pitchers (tendril coiled) ovoid-cylindric, green, slightly maroon above, 21.5 × 6.5 cm, widest in the ovoid basal third, narrowing to ca. 5 cm wide in the cylindrical upper part; outer surface with same indumentum as lower pitcher; fringed wings reduced to ridges apart from two foliose flaps immediately below peristome, point of attachment 3–4 mm long, angular-elliptic, 9 × 6 mm, bearing fringes 2–7 mm long; mouth ovate-lanceolate 7 × 4 cm, oblique, concave, the frontal part straight; column ca. 1.5 × 0.8 cm; peristome rounded-flattened, 1.75–5.5 mm wide, widest at sides, ca. 1.75 ridges per mm, ridges 0.1 mm high, inner edge lacking conspicuous teeth or holes, outer edge not lobed. Lid ovate-triangular, 5 × 3.8–4.2 cm, apex rounded, base truncate; lower surface with a weakly developed, convex basal appendage 1.5 mm high, arising from a low basal ridge 7 mm long; nectar glands ca. 16 on each side of the midline, sparsely scattered, more or less absent from midline, but present at appendage, nectar glands orbicular or slightly elliptic, slightly or strongly perithecoid, 0.25–0.5 × 0.25–0.45(–0.75) mm; sessile glands 0.05–0.1 mm diam., 8–20 per mm^2; upper surface of lid with indumentum as outer surface of pitcher. Spur inserted 2 mm below junction of lid and pitcher, pointing downwards, terete, 17 × 0.9–1 mm, dilating to the 1.8 mm wide rhombic-acute apex, indumentum moderately dense of long patent simple hairs as on the pitcher outer surface. Male and female inflorescences unknown.

Distribution and habitat

Philippines, Mindanao, Bukidnon Province, known only from Mt Kitanglad; epiphytic in mossy forest, geology volcanic, elevation 1800–2100 m.

Conservation

Here *N. kitanglad* sp. nov. is assessed as Critically Endangered since it is known from only a single location, Mt Kitanglad, on an island which has seen extensive forest clearance for logging and agricultural expansion in recent years (McPherson 2009: 759). For these reasons one species, *N. robcantleyi* Cheek is already suspected to be extinct in the wild (Cheek 2011). *Nepenthes kitanglad* sp. nov. is not a spectacular or especially bizarre species so is unlikely to come under pressure of collection for the horticultural trade which has brought several species of the genus close to extinction.

Remarks

McPherson (2009: 755–759; figs 417 & 418) depicts from volcanic Mt Kitanglad in N-Central Mindanao a plant under the name of *N. saranganiensis* Sh.Kurata (Kurata 2003: 41). Yet, the Kitanglad plants he depicts differ from *N. saranganiensis* as depicted in its protologue in habit, habitat and in morphology. In 2013 sheets of *Gaerlan et al. in PPI 3274* (BISH, BRIT) became available from Kitanglad. These matched McPherson's (2009) depiction, enabling a detailed comparison to be made with *N. saranganiensis*. The conclusion is that the Kitanglad material represents a different species from *N. saranganiensis* and is here described as *N. kitanglad* sp. nov. Differences between the two taxa are given in Table 2.

N. kitanglad sp. nov. is unusual in the *N. alata* species group (Cheek & Jebb 2013d) in the strongly concave mouth of the upper pitchers, in which the base of the lid is held over the mouth. It is also unusual in that the rear of the peristome narrows to a neck, forming a moderately well-defined column for the lid. Within the *N. alata* group, these two features are otherwise currently known only in *N. hamiguitanensis* Gronem., Wistuba, V.B.Heinrich, S.McPherson, Mey & V.B.Amoroso (Gronemeyer *et al.* 2010), but that species is restricted to ultramafic Mt Hamiguitan in SE Mindanao and differs greatly in the shape of the upper pitchers which are stout, widest at the midpoint, with a funneliform lower half narrowing to a more slender, cylindrical upper half. It is possible that *N. hamiguitanensis*, *N. kitanglad* sp. nov. and *N. saranganiensis* are related since all have angled stems (or in the case of the last species, winged), a feature otherwise unknown in the otherwise terete-stemmed *N. alata* group. *Nepenthes kitanglad* sp. nov. is unique in the *N. alata* group in its lid posture, as seen from photographs and herbarium specimens. The lid is held at ca. 45° below the horizontal, largely concealing the mouth. In other species it is usually elevated above the horizontal, sometimes by ca. 45° (*N. saranganiensis*) or as much as 90° or more (*N. graciliflora* Elmer). So far, *N. kitanglad* sp. nov. is the only species of *Nepenthes* recorded from Mt Kitanglad.

Table 2. Diagnostic characters separating *N. saranganiensis* and *N. kitanglad* sp. nov.

	N. saranganiensis	***N. kitanglad*** sp. nov.
Habit	Terrestrial shrub	Climbing epiphyte
Habitat	Open, shrubby areas	Forest
Altitudinal range	700–800 m	1800–2100 m
Climbing stems	Terete, winged, wings 1.5–2 mm wide	Angled, wings absent
Lower & upper pitchers dimorphic?	Monomorphic-subdimorphic	Strongly dimorphic
Mouth	Ovate, flat to slightly concave	Lanceolate; strongly concave
Column	Absent	Present, 0.9 cm long
Lid posture	Elevated above horizontal by ca. 45º	Declinate below horizontal by ca. 45º
Lid nectar gland	Midline dense with large glands	Midline ± lacking glands
Lid basal ridge and appendage	Convex appendage present	Ridge only, appendage absent
Upper pitcher shape	Equally wide at base and apex, waisted at midpoint	Basal third widest, ovoid, tapering into the narrow, cylindric upper part

Nepenthes extincta Jebb & Cheek sp. nov.
urn:lsid:ipni.org:names:77134488-1
Fig. 3

Diagnosis

Differs from *N. mindanaoensis* Sh.Kurata in the pitchers lacking fringed wings (versus with fringed wings), the lid base truncate (not cordate), the indumentum of the midrib of dense minute grey-white stellate hairs, (not of sparse black bristle-like hairs).

Etymology

Nepenthes extincta sp. nov. is named to signify that this species may already be extinct globally.

Type

PHILIPPINES. Mindanao Island "Red Hills (= 400 m alt.), SE of Claver, near the northeastern coast of the Mindanao Island. Boundary of the Surigao del Sur and Surigao del Norte" 8 Aug. 1978, *Fumihiro Konta 12365* (holotype BISH!).

Description

Terrestrial shrub, probably about 1 m tall. Leaves elliptic to elliptic-lanceolate, 13–17 × 5.5–8 cm, thickly leathery, glossy above, matt mid brown below; apex obtuse to acute, not peltate; base rounded to obtuse, not decurrent; longitudinal nerves arising from base of blade, where 5–6 pairs arise on each side of the midrib, at blade midpoint 4–5 pairs occur in the outer third of the blade; pennate nerves arising at ca. 45° from the midrib, irregularly branching, ends traversing the inner longitudinal nerves; all nerves most conspicuous on upper surface; midrib deeply depressed on upper surface, lacking hairs, highly exserted on lower surface and densely (80–90% cover) grey-white stellate hairy, the hairs gathering dirt, hairs sessile, arms 5–8, 0.25–0.5 mm diam., fine, acute, appressed to surface; lower surface of blade sparsely hairy, densest towards midrib, ca. 15% cover, decreasing at margin to 5–10%, cover, hairs mainly stellate, as midrib, mixed with sparser erect, bristle-like hairs 1–2 mm long, of several types (1) with short branches arising along the length of the main axis; (2) with 2–6 ± equal erect arms; (3) with a single long erect bristle arising from a stellate hair, the "dagger-hair" of Kurata (2003) more rarely (4) hairs with 2–3 erect, equal arms from the base; depressed-globose sessile red-black glands 0.03 mm diam., raised, dense, conspicuous; upper surface of blade with stellate hairs, as lower surface, scattered along the margins of the midrib. Petiole 4.5 × 0.5–0.7cm, appearing cylindric due to the two involute wings, indumentum of appressed, stellate, fine 5–8-armed hairs, ca. 20% cover. Lower and upper pitchers unknown, possibly not produced. Intermediate pitchers (tendrils not coiled, fringed wings absent) ovoid-cylindric, 18–24 × 5.9–8.2 cm, widest in the basal half, narrowing gradually to the cylindric upper half (4.8–5.5 cm wide), not constricted or waisted; outer surface 10–20% covered in minute, white, 2–4-armed, bushy-stellate hairs 0.12–0.15 mm wide and high, the arms stout and raised, 10–15 hairs per mm^2, mixed with sparser black depressed-globose sessile glands 0.07 mm diam., 4–5 per mm^2, long simple and bristle-like hairs absent; fringed wings absent, reduced to ridges; mouth ovate 7–8 × 4.5–5.5 cm, oblique, concave, column weakly defined ca. 1.5 × 0.7 cm; peristome subcylindric, 7–8 mm wide, widest at sides, outer edge lobed, lobes 1–3 per side, 10–12 mm wide, inner side inconspicuously toothed, teeth 0.25 mm long; ridges 4 per mm, 0.1 mm high. Lid ovate 5.2–6.5 × 4–5.2 cm, apex rounded, base truncate, lower surface with a basal ridge ca. 8 mm long, 1–2 mm high, bearing a pronounced straight convex appendage 4 × 2.5–5 mm; nectar glands of two distinct size classes (1) smaller, elliptic or orbicular, frequent, bordered glands 0.3–0.6(–0.7) × 0.25 mm, the border ca. 0.1 mm wide, glossy pale brown, dense, (1(–2) per mm^2) along the midline these are longitudinally elliptic, elsewhere with their short axis orientated towards the base of the lid; the appendage completely covered in smaller type nectar glands; (2) larger glands elliptic to orbicular, (1–)1.25–2 × 1.25 mm, the

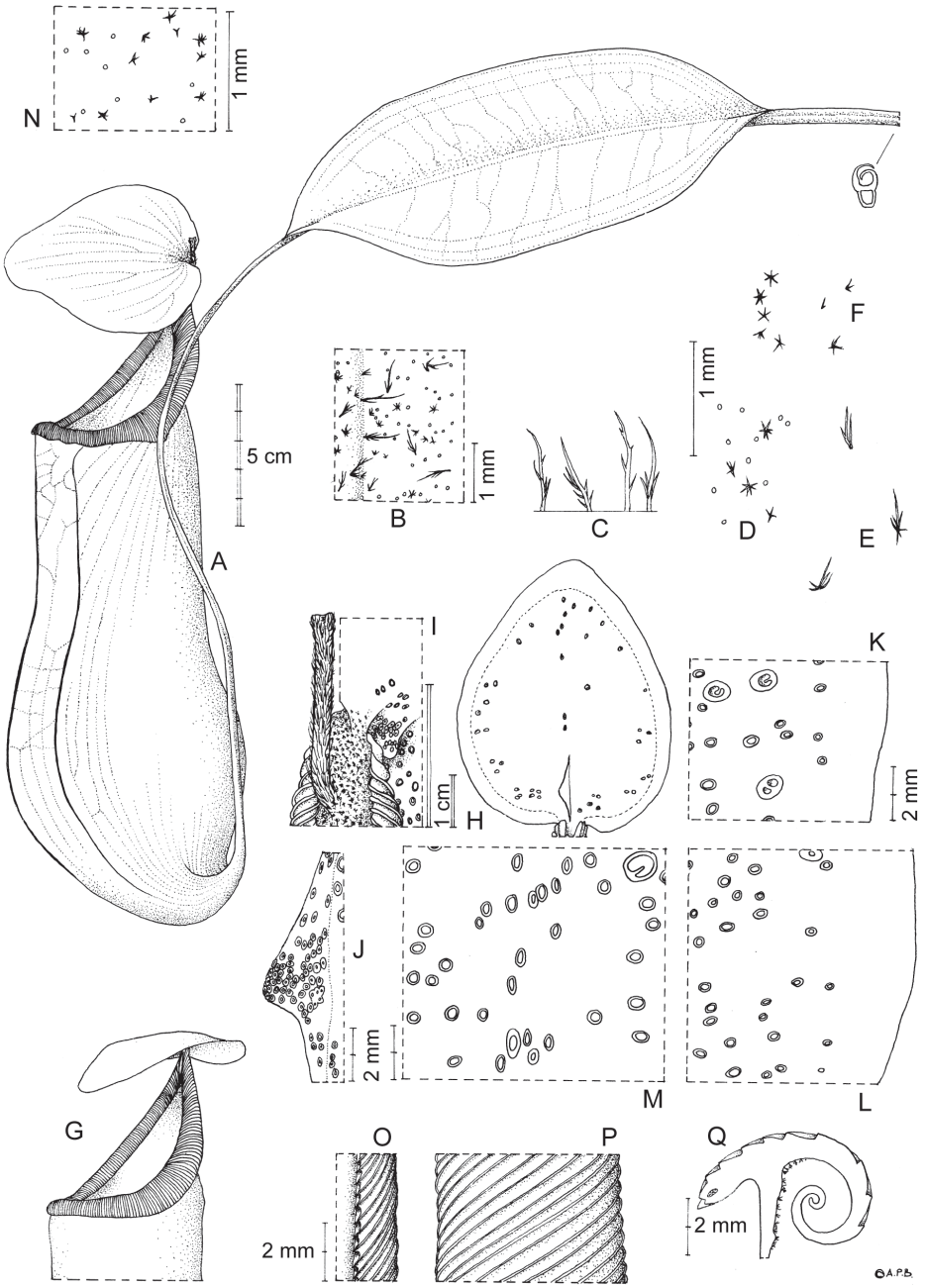

Fig. 3. *Nepenthes extincta* sp. nov. **A**. Habit, showing intermediate pitcher. **B**. Indumentum, lower surface of blade (midrib on left). **C**. Branched bristle hairs (detail from lower surface of blade). **D**. Stellate hairs and sessile glands (detail from lower surface of blade). **E**. Branched erect hairs (detail from lower surface of blade). **F**. Stellate hairs, with appressed arms, leaf-blade lower surface, near midrib. **G**. Upper part of intermediate pitcher, lid posture as in life. **H**. Lower surface of upper pitcher lid. **I**. Basal lid appendage and spur. **J**. Basal lid appendage and ridge, side view. **K-M**. Details of nectar glands, lower lid surface. **N**. Indumentum, outer surface of pitcher. **O**. Peristome, view from inside pitcher showing minute teeth and holes at edge. **P**. Peristome, view from above. **Q**. Transverse section of peristome (outer surface on right). A–F & H–Q from *Konta 12365*, G from sketch by M. Cheek. Scale bars: double, graduated = 5 cm; single = 1 mm; single graduated = 2 or 3 mm as indicated. All drawn by Andrew Brown.

lumina often invaginated by a projection of the border, border 0.2 mm thick, 4–15 on each side of the lid, scattered around the margin and towards the apex of the midline; sessile, depressed-globose, red glands, 0.05 mm in diam., 1–2 per mm^2; marginal 0.5–1 mm of lower surface with minute branched hairs 0.1 × 0.1 mm; upper surface with indumentum as outer pitcher. Spur inserted 5–6 mm below junction of lid with peristome, cylindric 8–14 × 1–1.2 mm, apex shortly bifid, surface covered in minute appressed, matted, white-grey stellate hairs. Male and female inflorescences and infructescence unknown.

Distribution & habitat

Philippines, Mindanao, Surigao del Sur. Open scrub habitats on ultramafic substrate with *N. merrilliana* Macfarl. (Macfarlane 1911) and *N. graciliflora* Elmer (Elmer 1912). Elevation: ca. 400 m.

Conservation

Nepenthes exincta sp. nov. is here assessed as Critically Endangered under Criterion D of IUCN (2012) since only a single individual has ever been recorded (the type specimen collected in 1978). The locality data given corresponds with the large area of ultramafic known as 'Red Mountain' SE of Claver in NE Mindanao. In fact, Red Mountain is a series of low red hills. The NE Mindanao, probably due to its large areas of ultramafic substrate, supports several narrowly endemic and often spectacular *Nepenthes* species, several of which are known from single locations. For this reason, it has been intensively visited in recent decades by devotees of the genus. Despite this, no additional collections or observations of this taxon have come to light in the last 25 years and it is possible that it is restricted to the Red Mountain, and is now extinct, since this happens to be the largest nickel mining site in the world's second largest nickel producing country (Gallares 2013). The Foundation for the Philippine Environment (Pacudan 2013) recently reported on the environmental damage due to extensive and massive nickel mining "as far as your eyes can see.", "The scene of endless open pit mining at the red mountain made our heart bleed." (Pacudan 2013). The biggest mining companies operating at the Red Mountain are Taganito Mining Corporation, Platinum Group Metals Corporation (PGMC), Taganito HPAL Nickel Corporation, Adnama Mining Resources Inc. (AMRI) and Zhen Shou Mining (Almeda 2012). It is much to be hoped that this species is refound, and not proved to be extinct, and if found, that it can be protected and monitored.

Remarks

Nepenthes extincta sp. nov. is most likely to be confused with *N. mindanaoensis* and they may share a common origin. Both species occur on open ultramafic substrates in NE Mindanao, both have robust, ovoid-cylindric pitchers arising from thickly leathery blades in which the longitudinal nerves arise from the base of the blade. In both species the petiole has involute wings, so appear cylindric, and the blade is not decurrent to the petiole – unusual features in the *N. alata* group. The two can be distinguished using the characters in Table 3. The two species are not sympatric so far as is known.

Fumihiro Konta, collector of the only known material of this species, has not been traced by us. An internet search shows that he has published on the plants of S China and Thailand, as well as Japan, covering specialisms such as Asclepiadaceae, Ferns and Vegetation mapping. "A list of the Ferns and Flowering Plants of Mt Fuji, 1984" is his most referenced work. Since "Environmental Impact Studies" are listed among his interests, it may have been in that context that he collected the type specimen recorded here.

Table 3. Diagnostic characters separating *N. extincta* sp. nov. from *N. mindanaoensis*.

	Nepenthes extincta sp. nov.	***Nepenthes mindanaoensis***
Indumentum of leaf-blade (lower surface of midrib)	Densely covered in grey-white stellate hairs 0.25–0.5 mm diam., arms 5–8, fine, appressed to surface	Sparsely covered in brown or black, erect bristle-like hairs 1–1.5 mm long
Intermediate/Upper Pitchers shape	Ovoid basal half gradually tapering into cylindric upper half	Ovoid basal third abruptly narrowing to cylindric upper two-thirds
Fringed wings	Absent from intermediate pitchers	Present on lower, intermediate and upper pitchers
Lid base	± truncate	Markedly cordate
Basal appendage of lid	Strongly developed	Absent

Nepenthes leyte Jebb & Cheek, sp. nov.
urn:lsid:ipni.org:names:77134489-1
Fig. 4

Diagnosis

Differs from *N. alata* B lanco in having, except in the hairy axils, glabrous stems, (not densely white hairy); upper pitchers lacking fringed wings (versus with fringed wings); nectar glands on lower surface of lid dimorphic, concentrated around margin and appendage (not monomorphic, uniformly dense and distributed).

Etymology

The specific epithet "leyte" is here used as a noun in apposition, to commemorate the island of that name, to which the species appears unique.

Type

PHILIPPINES. Eastern Visayas, Leyte, Mt Lobi, near Dagami, 7 Nov. 1999, *Argent, Mendum, Fuentes, R., Belonias, B.S. 99214* (holotype K!; isotypes E!, PNH).

Description

Terrestrial climber, height 2 m (probably), drying brown. Climbing stems subterete, 4–6 mm diam., with a slight ridge below the leaf bases; the axil with a shallow groove containing a spike-like bud 1–2 mm long, inserted 5–6 mm above the axil; internodes 3–7 cm long; surface with scattered red-black, depressed-globose, sessile raised glands 0.05–0.08 mm diam.; hairs absent, except in the axillary grooves which have white, moderately dense, basally branched hairs with arms erect, ca. 1 mm long. Rosette stems and leaves unknown. Leaves of climbing stems spirally inserted, thinly leathery; blade narrowly oblong-elliptic, 13.5–16 × 2.5–3.8 cm; apex acute, not peltate; base cuneate, abruptly decurrent to the petiole; longitudinal nerves 1 pair, moderately close to the margin, inconspicuous; pennate nerves numerous, conspicuously raised on both surfaces, more or less patent, irregular; both surfaces drying brown, subglossy above, matt below; midrib on both surfaces 5–10% covered with fine white-translucent simple or 3–5-armed stellate hairs, on the upper surface 0.2–0.3 mm diam., on the lower surface 0.1–0.2 mm diam., the leaf-blade otherwise glabrous, apart from sessile red-black glands as the stem, 0.05–0.1 mm diam., 2–6 per mm^2. Petiole evenly winged along its length, the wings incurved (field notes); (2.5–)3–4.5 × 0.2–0.4 cm; clasping the stem for ½ its circumference, very shortly decurrent by

1–2 mm. Lower and intermediate pitchers unknown. Upper pitcher (tendril coiled) 12–15 × 4.5–5 cm; ovoid-ellipsoid in the lower half, upper half cylindrical, 3–3.5 cm diam., not constricted at any point; outer surface 10–30% covered in minute red stellate hairs, hairs ca. 0.1 mm diam., both sessile and shortly stalked, 4–6-armed, arms suberect or patent, density 3–5 per mm^2, mixed with sessile red-black glands 0.05 mm diam. as the leaf-blade and stem, hairs denser on lid, and towards the peristome where they are mixed with sparse erect bushy-bristle hairs 0.2–0.3 mm long; "almost uniformly green with a few purple spots mainly on the ventricose base" (*Argent et al. 99214*); fringed wings are absent, reduced to inconspicuous ridges; mouth ovate, 4–4.5 × 3–3.5 cm, oblique, slightly concave, "glaucous green inside with just a few red spots"; peristome (1–)2–3(–5) mm wide, narrowly subcylindrical, rounded at the front, becoming slightly flattened and widest at the sides, towards the lid, ca. 4 ridges per mm, ridges 0.075–0.15 mm high, inner edge inconspicuous, holes and teeth not visible (unless dissected: Fig. 4P); outer edge not lobed; column weakly developed, ca. 7 × 3 mm. Lid ovate 3.2 × 2.9(–3.2) cm; apex shallowly retuse, the sinus 3–7 mm wide; base cordate, the sinus 4 mm deep, 8–15 mm wide; green; margin undulate; lower surface with convex basal appendage, 0.4–0.7 × 1–2 mm, arising from near the midpoint of the 5–6 × 0.5 mm long basal midline ridge; nectar glands slightly dimorphic, each with a different distribution: (type 1) moderately dense on the basal ridge and appendage (Fig. 4L) and in a ca. 2 mm band each side (but not extending along midline), glands with raised borders, shortly elliptic, 0.1–0.2(–0.3) mm long; (type 2) slightly larger, (0.1–)0.2–0.3 mm long, moderately dense, in bands 2–4 mm wide along the lid margins, 25–40 glands on each side, one sheet (atypical?) with a few additional large elliptic glands, 0.7 × 0.4 mm, bordered, very sparsely scattered between the margins; sessile red-black glands, as stem, leaf and outer pitcher surface, 0.005–0.01 mm diam., scattered over surface ca. 3 per mm^2; marginal part of lower surface with a few minute stellate hairs. Spur inserted 2 mm below junction of lid and pitcher on ridge; simple, stout at base tapering to a long, acute apex; 7–9.5 × 0.5–0.7 mm; completely covered in long, grey appressed hairs, hairs (0.5–)0.7–1(–1.2) mm long. Upper surface of lid with two prominent nerves, nerves densely (80–90% cover) white hairy, hairs of two types: (1) basally 1–2-branched hairs 0.3–0.4 mm long, (2) minute 3–5-armed stellate hairs 0.1 mm diam.; remainder of lid surface with type (2) hairs, but indumentum 30–40% cover, and with sparse perithecoid nectar glands 0.25 mm long. Inflorescence and infructescence unknown.

Distribution & habitat

Philippines, Visayas, Leyte; volcanic geology; "climbing on fallen tree in submontane mossy forest", elevation 900 m (*Argent et al. 99214*).

Conservation

Nepenthes leyte sp. nov. is known currently from a single individual in an unprotected area, in a country, including specifically the island of Leyte, where most of the original forest habitat has been cleared for timber and agricultural land and where forest degradation and clearance are ongoing (Myers *et al.* 2000; GoogleEarth viewed 2 Oct. 2013). Accordingly, it is here assessed as Critically Endangered under Criterion D of IUCN (2012). It is to be hoped that further exploration will reveal additional localities for the species, and that protection can be arranged before it becomes extinct. Currently no protected areas are believed to be present on Leyte apart from the 2193 ha Lake Danao National or Natural Park which is about 14 km to the W of the type location. However this seems to be mainly a recreational area, and within the reserve, illegal settlement, slash and burn agriculture and illegal logging are reported to be problems (http://en.wikipedia.org/wiki/Lake_Danao_(Leyte)#Threats, viewed 12 Oct. 2013). Viewing the area immediately around Lake Danao on GoogleEarth (2007 imagery, viewed 12 Oct 2013) confirms that large areas have been and were in 2007 in the process of being cleared and inhabited, and that these activities extend towards the E and the only known location for *N. leyte* sp. nov. Some original forest still survives along the central high ridge of Leyte, where terrain appears rugged, including the location indicated as the type location of the species, however the resolution of the imagery here is not

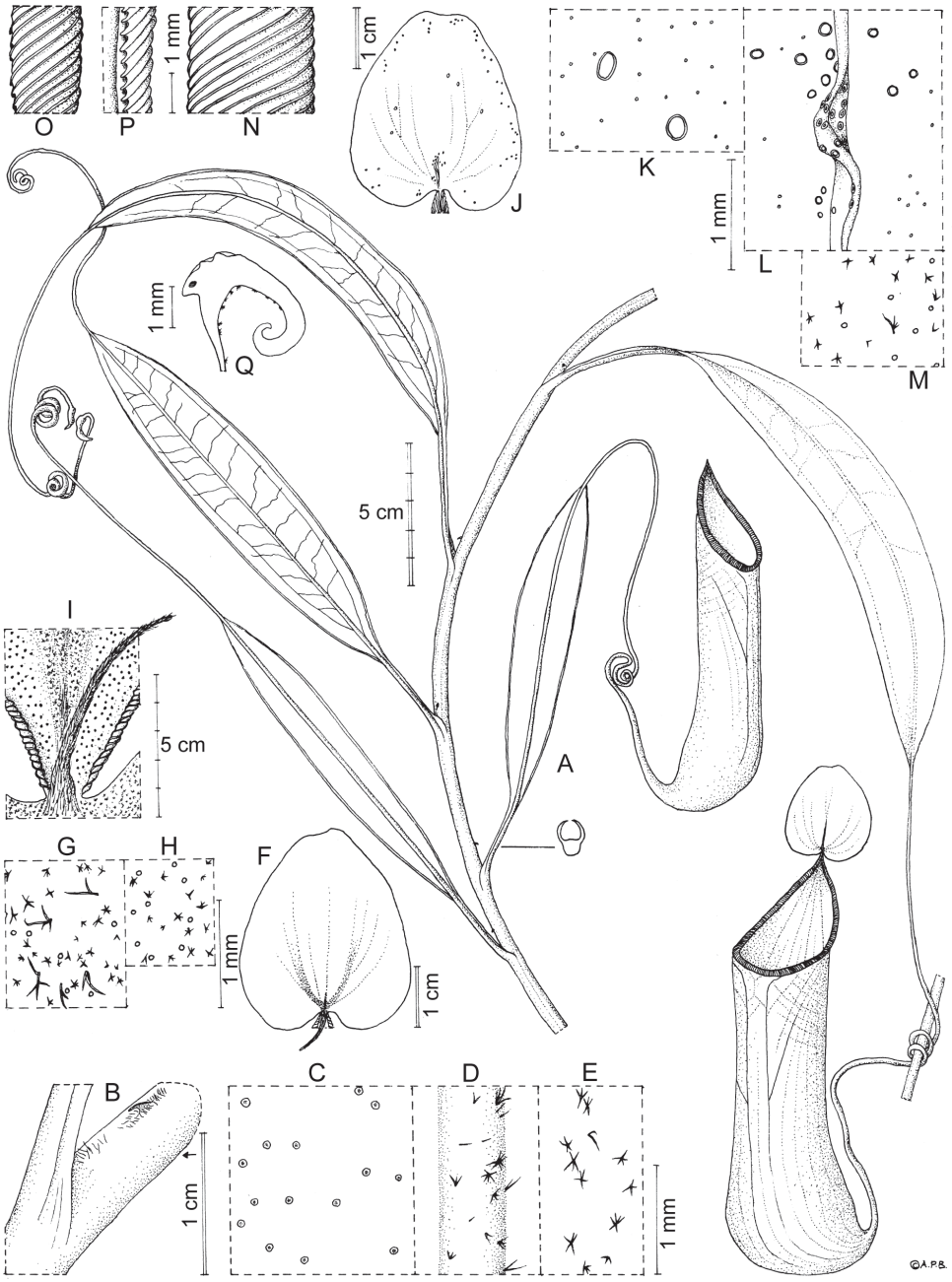

Fig. 4. *Nepenthes leyte* sp. nov. **A**. Habit, climbing stem with upper pitchers. **B**. Stem section showing axillary hair patch and supra-axillary bud. **C**. Lower surface of leaf-blade, with sessile glands. **D**. Midrib of leaf-blade, lower surface, stellate to simple hairs. **E**. Midrib of leaf-blade, upper surface with stellate hairs. **F**. Upper lid of pitcher, upper surface. **G**. Indumentum of upper surface of lid, over nerve. **H**. As G but distant from nerve. **I**. Spur of upper pitcher and junction of lid with peristome (inverted). **J**. Lid of upper pitcher, lower surface. **K**. Detail of J showing large nectar glands. **L**. Detail of J showing midline ridge with appendage and type (1) nectar glands. **M**. Indumentum of outer pitcher surface. **N**. Peristome of upper pitcher viewed from above. **O**. Peristome viewed from inside pitcher. **P**. Peristome dissected to expose the inner edge, with teeth. **Q**. Peristome, transverse section (outer surface on right). All drawn from *Argent et al. 99214* by Andrew Brown.

sufficiently high to gauge how intact the habitat is. The eastern side of Leyte has higher rainfall and the forest has extensively been replaced by intensive industrial oil palm plantations which extended in 2003 to within 4 km of the type location (GoogleEarth imagery dating from 2003, viewed 2 Oct. 2013). Collection of *Nepenthes leyte* sp. nov. from the wild to supply the horticultural trade is considered a low risk for this species since its pitchers are not as spectacular or as bizarre as those of other members of the genus in the Philippines.

Remarks

Argent et al. 99214, here described as *Nepenthes leyte* sp. nov., while superficially similar to *N. graciliflora*, the only other species of the genus known on Leyte (*Wenzel 680*, GH!; *Barbon et al. in PPI 8735*, BRIT!; *ibid. 8561*, BRIT!), cannot be confused with it. This is due to the stellate hairs present on the outer pitcher surface of *Nepenthes leyte* sp. nov. (versus absent in *N. graciliflora*), and the dimorphic nectar lid glands concentrated around the margin and appendage (not monomorphic, uniformly dense and distributed). It also has petioles that appear cylindrical since the wings are involute (not with patent wings). Apart from *N. graciliflora* itself, only one other member of the *N. alata* group is, so far, known from the Visayas: *N. negros* (Negros and Biliran islands). However, *N. negros* has densely hairy stems (versus glabrous), upper pitcher with fringed wings (not absent) and the inner peristome edge has conspicuous teeth and holes (versus conspicuous teeth absent). *Nepenthes leyte* sp. nov. can be distinguished from other species of the *Nepenthes alata* group using the key above.

Discussion

In an earlier paper, the *Nepenthes alata* group of species, confined to the Philippines, was characterised and a key was provided to the then recognised species (Cheek & Jebb 2013d). In that paper the species of the *N. alata* group were characterised as possessing: (1) a basal appendage on the lower surface of the pitcher lid, (2) a terete stem, (3) a distinct, but winged petiole, the petiole wings wide, decurrent from the blade, (4) the peristome finely ridged, the outer edge not or only slightly lobed, (5) the inner surface lacking conspicuous teeth, (6) the mouth ovate, oblique, without a well-developed column (Cheek & Jebb 2013d).

The four new species described here have characters that necessitate modification of the *Nepenthes alata* group as circumscribed in Cheek & Jebb (2013d). All but *N. leyte* sp. nov. of the new species have stems that can be 4-angled in section rather than terete. In *N. extincta* sp. nov. and in *N. leyte* sp. nov., the petiole wings are incurved, the two edges overlapping, giving the petiole a cylindrical appearance. Both *N. extincta* sp. nov. and *N. kitanglad* sp. nov. have broad, partly flattened peristomes (rather than narrowly cylindric) and pitcher mouths which are concave (rather than straight). In the case of *N. kitanglad* sp. nov., a moderately well-developed column is formed (rather than none, or a weakly developed column). Several of these characters are more usual in the *Regiae* group of species of Danser (1928), which are considered by us to be closely related to the *N. alata* group. The two species groups share (1) petiolate leaves and, (2) on the basal part of the lower surface of the lid, appendages emerging from a keel-like ridge or crest, and (3) inflorescences with 2-flowered partial-peduncles. The two species groups can be both defined and separated from each other using the key below. It is possible that future discoveries will provide evidence that the two groups are a continuum, and should be united.

– Upper pitchers infundibuliform or infundibuliform-cylindrical, always widest at the peristome; petioles not or weakly winged, U-shaped in section, the wing width if present, shorter than the width of the central, non-winged part of the petiole; stem and leaf indumentum of persistent, red-brown bristle-like hairs. BORNEO, SULAWESI & NEW GUINEA ..... ***Regiae*** species group (Danser 1928)

– Upper pitchers usually ovoid-cylindrical, rarely subcylindrical, always widest in the basal half (except in *N. ceciliae* and *N. copelandii*); petiole wing width wider than the width of the central, non-winged part of the petiole, wings either held flat or inrolled and then the petiole appearing cylindrical. PHILIPPINES EXCLUDING PALAWAN .... ***N. alata*** species group (Cheek & Jebb 2013d)

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